is involved in these effects, it may be held that the detection of a uniform drift of the solar system in this way is not contrary to the principle of relativity. It is contrary to some statements of that principle; and the cogency of those statements breaks down, I think, whenever they include the velocity of light; because there we really have something absolute (in the only sense in which the term can have a physical meaning) with which we can compare our own motions, when we have learned how.

But in ordinary astronomical translation —translation as of the earth in its orbit— all our instruments, all our standards, the whole contents of our laboratory, are moving at the same rate in the same direction; under those conditions we can not expect to observe anything. Clerk Maxwell went so far as to say that if every particle of matter simultaneously received a graduated blow so as to produce a given constant acceleration all in the same direction, we should be unaware of the fact. He did not then know all that we know about radiation. But apart from that, and limiting ourselves to comparatively slow changes of velocity, our standards will inevitably share whatever change occurs. So far as observation goes, everything will be practically as if no change had occurred at all —though that may not be the truth. All that experiment establishes is that there have so far always been compensations; so that the attempt to observe motion through the ether is being given up as hopeless.

Surely, however, the minute and curious compensations can not be accidental, they must be necessary? Yes, they are necessary; and I want to say why. Suppose the case were one of measuring thermal expansion; and suppose everything had the same temperature and the same expansibility; our standards would contract or expand with everything else, and we could observe nothing; but expansion would occur nevertheless. That is obvious, but the following assertion is not so obvious. If everything in the universe had the same temperature, no matter what that temperature was, nothing would be visible at all; the external world so far as vision went, would not appear to exist. Visibility depends on radiation, on differential radiation. We must have differences to appeal to our senses, they are not constructed for uniformity.

It is the extreme omnipresence and uniformity and universal agency of the ether of space that makes it so difficult to observe. To observe anything you must have differences. If all actions at a distance are conducted at the same rate through the ether, the travel of none of them can be observed. Find something not conveyed by the ether and there is a chance. But then every physical action is transmitted by the ether, and in every case by means of its transverse or radiation-like activity.

Except perhaps gravitation. That may give us a clue some day, but at present we have not been able to detect its speed of transmission at all. No plan has been devised for measuring it. Nothing short of the creation or destruction of matter seems likely to serve; creation or destruction of the gravitational unit, whether it be an atom or an electron or whatever it is. Most likely the unit of weight is an electron, just as the unit of mass is.

OLIVER LODGE

(To be concluded)

A SUMMARY OF THE WORK OF THE U. S. FISHERIES MARINE BIOLOGICAL STATION AT BEAUFORT, N. C., DURING 1912

THE laboratory of the Bureau of Fisheries at Beaufort, North Carolina, was open as usual during the summer of 1912, and opened about the middle of June, 1913, to investiga-

tors engaged in the scientific and economic problems of the Bureau and to independent workers. Following is a brief summary of the work of the station and some of the results attained during the year 1912.

The laboratory continued its cooperation with the U. S. Weather Bureau, keeping a daily record of the maximum and minimum temperatures, precipitation (rain and melted snow), etc. These data were forwarded monthly to the Raleigh office.

Greatly needed improvements to grounds and buildings were begun during the year. The library was removed from the crowded laboratory to new quarters on the museum floor, and its contents are being arranged and catalogued according to the system used in the Washington office. A large number of state and other reports were received during the year, scientific works adapted to the needs of the station have been ordered, and an attempt is being made to assemble all publications relating to the fauna and flora of the region. All investigators who have or are publishing such papers are urged to forward separates to the library.

The cultural experiments with the diamond-back terrapin were continued with marked success, and the feasibility of terrapin culture on a commercial basis is practically assured. The 1912 brood numbered over 1,220, more than three times as many as in 1911, and indications are that for the stock of adults on hand the maximum has not been reached. This brood, with those of 1911, 1910 and 1909, makes a total of over 1,900 young terrapin hatched in the enclosures at the laboratory. In the fall of 1911 and spring of 1912, 66 adult terrapin from Texas were purchased, and from the eggs laid by these a sufficient number of young were obtained to begin the experimental work with this form. Professor W. P. Hay had general supervision of much of this work.

It is the purpose of the laboratory to collect all possible data bearing on the fishes of the South Atlantic region, to conduct fish-cultural experiments to show the feasibility of increasing the annual yield by artificial propagation, and to add to knowledge of the life-histories of as many forms as possible. As a basis for this work, the compilation of all existing information on the local fishes has been undertaken. A card catalogue of species and a systematic list with synonymy of published references for the region are practically completed, about 235 species being represented.

In an examination of old collections in the laboratory several examples of a mad-tom, *Schilbeodes gyrinus* (Mitchill), from Lake Mattamuskeet, N. C., were found. This is believed to be the first record south of the Potomac River at Washington, D. C. Two additional species not previously reported from North Carolina were taken during the summer. The first, a galeid-shark, *Hypoprion brevirostris* Poey, represented by two examples, had been reported as far north as Charleston, S. C.; one specimen was 7½ feet long, the largest recorded. A southern sting-ray, *Dasyatis sabina* (Le Sueur), was also taken. This species appears to be quite abundant and has probably been confused heretofore with small examples of some of the other species. An example of *Carcharhinus acronotus* (Poey), the second record for the coast, was also obtained. A fine example of the interesting ray *Mobula olfersi* (Muller & Henle) was presented to the laboratory by Mr. Russell J. Coles.

On July 26, 1912, a beaked whale (*Mesoplodon*) 16 feet long was stranded on Bird Island Shoal in the harbor. The head, tail and one of the pectoral fins were sent to the U. S. National Museum, where Dr. F. W. True found it to be an undescribed species and has since given to it the name *M. mirum*.[1]

The investigators and independent workers have furnished the data on which the following brief summary of their work is based:

Professor W. P. Hay who, during July, August and September, continued his work on the propagation of the diamond-back terrapin, also spent considerable time on the study of the crustacean fauna of the Beaufort region, and began a series of experiments on the artificial propagation of the loggerhead turtle.

[1] *Smithsonian Misc. Coll.*, Vol. 60, No. 25, March 14, 1913.

Early in July a nest of the loggerhead turtle, containing 135 eggs, was found on the ocean beach of Bogue Bank. The eggs were removed to the laboratory and placed in hatching boxes, and 75 young turtles were hatched and retained until winter. The economic value of the loggerhead turtle is at present very small, but the data secured from the experiments at the laboratory will doubtless be useful if an effort is ever made to cultivate more valuable species of sea turtles.

The decapod crustaceans of the Beaufort region were studied some years ago by Dr. H. A. Shore, but pressure of other matters made it impossible for him to complete his report. It is this unfinished work that has been taken up by Professor Hay and is being put in shape for publication.

Dr. H. S. Davis, of the University of Florida, devoted his time largely to studying the life-history of a dimorphic species of *Myxosporidia* occurring in the urinary bladder and ureters of the squeteague, *Cynoscion regalis*. This species occurs in two very different forms (one disporous, the other polysporous) and possesses many characters of great interest, notably a method of reproduction by internal budding hitherto unknown in the *Myxosporidia*. The development of the spores was worked out in detail and has been found to differ in many respects from the published accounts of spore formation in other species. The account of this work will shortly be ready for publication. Observations were made on a number of species of *Myxosporidia* occurring in the gall bladders of sharks and others inhabiting other marine fishes, and a considerable amount of material was preserved for future study.

Dr. J. F. Abbott, of Washington University, St. Louis, Mo., conducted various experiments on the fiddler crab (*Uca*), which abounds in the neighborhood of Beaufort Harbor.

(*a*) The question of the relative permeability of tissues and particularly of gill membranes to pure distilled water is still an open one. *Fundulus heteroclitus* appears to be impermeable to and unaffected by immersion in pure distilled water. From the apparent immunity of the fiddler crab to fresh and distilled water it appears at first that it, like *Fundulus*, offers a similar exception to the rule that animal membranes are freely permeable. It was discovered after prolonged experiment that the crab stores up very small quantities of sea water in its gill chamber, with which it modifies the pure water sufficiently to preserve its life. If the gill chamber be cut away and the cavity washed out, this immunity disappears and the crab succumbs to the effect of the water with an increase of weight (indicating the penetration of water) and a loss of salts (discoverable by titrating the immersing medium for chlorides). If the amount of water be small the crab is able by emitting minute quantities of electrolytes to alter the medium sufficiently to nullify the destructive solvent action of the pure water on the gill-membranes. An account of this portion of the work has been published in the *Biological Bulletin* of the Marine Biological Laboratory at Woods Hole, Mass. (Vol. 24, p. 169, 1912).

(*b*) Other lines of experiment on the nullifying action of one poisonous component of the sea water by another were carried out, leading to results which in general substantiate J. Loeb's hypothesis of balanced solutions as worked out on marine vertebrates.

(*c*) In connection with the storage of water in the gill-chamber mentioned above, the morphology of the apparatus by means of which the crab is enabled to leave the water for long intervals of time was worked out. An opening is to be found between the third and fourth pereipods, which is fringed with hairs and leads up through a narrow channel to a space above the gills. It is provided with a valvular stop and with a structure which appears to function as a sense organ. It was ascertained that the crab does not "breathe air" as frequently stated, but aerates the water thus retained in its gill chambers.

(*d*) During the summer of 1912 a large number of fiddler crabs were captured and preserved for the purpose of determining the variation constants and the establishment of "place modes." It is planned to continue the work for a number of seasons in order to de-

termine if possible what effect climatic and environmental factors may have on the variability of the species. The now completed laborious task of measuring (involving over 10,000 measurements under a magnifying glass) has been carried out in the laboratory of the department of zoology of Washington University.

Dr. Abbott also made studies of the blood of *Thallasema,* an echiurid worm that inhabits the dead tests of the "sand dollar." This fluid is interesting from the standpoint of its corpuscles, which, like those of vertebrates, are of two kinds—ameboid forms and hemoglobin-bearing, respiratory cells. The individual cycle of these cells and their probable functions were worked out during the latter part of the summer, and the results are in press in the *Washington University Quarterly.* In about twenty-five per cent. of the worms studied the hemoglobin-bearing corpuscles formed were found to be parasitized by an undescribed species of *Hæmogregarina*—the first record of a hæmosporidian parasite in an invertebrate host. Portions of the life cycle of the form were worked out, and it is hoped to complete this at some future time.

Mr. L. F. Shackell, instructor in pharmacology, St. Louis, University School of Medicine, was engaged in a study of methods for protecting wood against the attacks of marine borers. Nearly seventy pieces of wood were coated with mixtures containing a variety of poisons, and are being allowed to remain in the water of Beaufort Harbor for nine months, the last three of which will coincide with the breeding season of *Teredo* and *Limnoria.*

Professor H. V. Wilson, of the University of North Carolina, spent a part of the summer in an investigation bearing upon the question of the reciprocal interaction of cells of different species, his observations dealing especially with the behavior of the amœbocytes in the lymph of the sea urchins *Arbacia* and *Toxopneustes.*

Dr. James J. Wolfe, professor of biology in Trinity College, Durham, N. C., spent seven weeks at the laboratory completing his investigation of *Padina,* begun here in the summer of 1910, so far as the work which had to be done at the seaside is concerned. Forty-eight cultures of eggs and tetraspores were started in aquaria in the laboratory and later transferred to various localities in the harbor. These were collected on a special trip made to Beaufort, September 25. A subsequent examination, not yet quite complete, shows fairly conclusively an alternation of a sexual with an asexual generation. From July 18 to September 1 general records were kept covering rate of growth, formation of hairs, and periodicity in the production of sex organs. The foregoing, together with a cytological examination at critical stages, is now being incorporated in a paper on "The Life History of *Padina.*"

Dr. A. J. Goldfarb, of the College of the City of New York, visited the laboratory from August 6–17 in order to continue certain experiments begun earlier in the season at the Marine Biological Laboratory of the Carnegie Institution, on the grafting of eggs together and on certain changes produced by chemical means. Extensive dredging operations about the harbor and close to the laboratory appear to have polluted the harbor waters, and it was found necessary to bring in sea water from outside the harbor to secure normal development of the fertilized eggs of *Toxopneustes variegatus* into perfect plutei larvæ. With this water the eggs when subjected to the action of a $\frac{5}{8}$ *M* NaCl solution tended to fuse together in large numbers, and to continue their fusion into various types of single and double organisms. These fusions were produced in the same manner and gave rise to the same types of fusions as those obtained at the Tortugas earlier in the season, and established beyond all question that this new method for the production of fused eggs and larvæ is superior, in simplicity, in absence of disturbing physical factors, and in the number of fusions, to the methods formerly used by the writer, by Driesch and by Herbst.

Dr. Albert Kunz, of the University of Iowa, studied the habits, the morphology of the reproductive organs and the embryology of the viviparous fish, *Gambusia affinis,* and the early

developmental stages of two species of teleosts whose eggs were found in the plankton.

Gambusia affinis is exceedingly abundant in the vicinity of Beaufort in all the freshwater streams entering the harbor and in the shallow brackish waters. This species is of economic importance as a destroyer of insects and insect larvæ. Wherever it inhabits waters in which mosquitoes breed, the mosquito larvæ constitute its principal food. The introduction of these fishes into the natural waters as well as into artificial ponds, aquatic gardens, etc., in mosquito-infested regions, may play an important rôle in the extermination of these pests.

One of the most interesting points studied by Dr. Kunz was the structure of the apparatus controlling the modified anal fin in the male *Gambusia*. This fin functions as an intromittent organ and is controlled by a powerful muscle which has its origin on a bony process projecting ventrally from the fourth to the last abdominal vertebræ and the modified anal spines of the first three caudal vertebræ and is inserted on the proximal end of the anal fin rays. The third, fourth and fifth rays of the fin are enlarged, greatly elongated and variously curved, bearing short spines on their distal portions. The interhemal which articulates with the third ray is enlarged and sufficiently elongated to articulate with the two anterior processes, on which the muscle controlling the anal fin has its origin. The fifth ray may be drawn forward at one side of the fourth and brought into proximity with the third. In this manner a groove or tube is formed through which the milt is transferred from the male to the female. The results of this work are to be published in the near future.

On August 3, 1912, pelagic eggs of the two species of teleosts were taken in the tow-net. Both are spherical in form and comparatively small, having a diameter of .6 to .7 mm. One kind, probably those of *Trichiurus lepturus*, are almost perfectly transparent and contain no oil-globule. The other, perhaps those of an engraulid, contain an oil-globule and numerous minute pigment spots. Eggs taken at the same hour on successive days were found to be in approximately the same stage of development. Spawning obviously occurs in the evening, probably between five and eight o'clock. Before six o'clock in the morning the embryo is well differentiated, and at 36 hours after spawning the little fishes are already hatched. Observations on the development of these two species are still incomplete. It is expected that these studies will be extended and the species positively identified.

Following the work of Thompson, Johnson, Tims and Dahl on the scales of the salmon and English brook trout, with special reference to age determinations and life-history indications, Mr. H. F. Taylor, of Trinity College, Durham, N. C., undertook to verify and amplify their conclusions by investigating the scales of an important American food fish, *Cynoscion regalis* being chosen.

Age may be determined with more or less accuracy by enumerating the annuli or supposed zones of growth. Various methods of bringing out these annuli clearly by stains, polarized light, etc., were employed. The results will be explained in a paper to be published shortly.

The evidences found by Mr. Taylor do not warrant the assumption that annuli are due to retarded growth, as was hitherto supposed, but they must be due to other causes which are at present somewhat doubtful. At all events it is fairly certain that if these fishes grow more slowly in winter than in summer there is no evidence of this on the scales. Distances between the annuli are found to represent, proportionately, the length of the fish at the times of the formation of the several annuli.

The nature of the radii was also studied. They were found not to be constant, but to vary with the activity of the fish and with the part of the body from which the scale was taken. The evidence indicates that they are hinges through the superior calcified layer to permit the scale to bend in adaptation to the motion of the body of the fish. On the head, etc., where there is no flexibility, there are no radii on the scales; and their number on scales

from other parts agrees with the shape, size and thickness of the scale and the motion of the part. If this conclusion stands it will seriously modify systems of classification employing radii as characters.

Messrs. William J. Crozier and Selig Hecht, of the College of the City of New York, who were assigned to the director for duty, accompanied the various collection trips, made extensive collections of fishes and kept a complete record of all observations, devoting special attention to those relating to the food, habits, rate of growth, relative abundance and distribution of the fishes taken. They also studied correlations among weight, length and other body measurements of the squeteague (*Cynoscion regalis*). The coefficient of correlation of weight and length and the constant, which if multiplied by the cube of the length gives the weight of the fish, were determined. Stomach contents of a large number of examples of this species were examined. The results indicate that the relative proportions of the forms of life commonly eaten depend upon the size of the fish and that the food varies with the locality.

Lewis Radcliffe,
Director

SCIENTIFIC NOTES AND NEWS

Professor William Bateson, director of the John Innes Horticultural Institution, has been elected president of the British Association for the Advancement of Science for the meeting which will be held next year in Australia.

On the occasion of the meeting of the International Geological Congress at Toronto, the University of Toronto conferred the degree of doctor of laws on the following geologists: T. C. Chamberlin, U. S. A.; W. G. Miller, Canada; P. M. Termier, France; R. Beck, Germany; J. J. Sederholm, Finland; T. Tschermyschev, Russia, and A. Strahan, England.

Professor Lillien J. Martin, professor of psychology at Stanford University, has had the honorary degree of doctor of philosophy conferred upon her by the University of Bonn.

Professor Bier and Professor Körte, of Berlin, have been named as honorary members of the Royal College of Surgeons in London.

According to a note in *The Observatory* the American astronomers present at the meeting of the Solar Union at Bonn were: Campbell, St. John and Burns, from California; Stebbins, from Illinois; Parkhurst, Slocum and Gingrich, from Yerkes; Schlesinger, from Allegheny; Russell and Shapley, from Princeton; Ames, from Baltimore; Doolittle, from Philadelphia; Nichols, from Cornell; Pickering, Bailey, Miss Cannon and Mrs. Hastings, from Harvard; Miss Whiting and Miss Allen, from Wellesley, and Plaskett, from Ottawa.

Dr. Carl Correns, professor of botany at Munster, has been appointed director of the Research Institute for Biology of the Kaiser Wilhelm Society. Dr. Spemann, professor of zoology at Rostock, has been appointed assistant director.

Prince Galitzin has become director of the Observatoire Physique Central Nicolas, St. Petersburg.

Mr. Aksel S. Steen has been appointed director of the Meteorological Institute of Norway, in succession to Dr. H. Mohn, who has retired.

Mr. C. A. McLendon, for the past five years botanist and plant-pathologist to the Georgia Experiment Station, in charge of plant-breeding investigations, has tendered his resignation to take effect October the first, after which date he expects to be engaged in private business.

L. F. Hawley, Ph.D. (Cornell), formerly in charge of the section of wood distillation and chemistry of the U. S. Forest Service, is now the director of a forest products department recently established by Arthur D. Little, Incorporated, Boston, Mass.

Dr. Calvert M. DeForest has been appointed deputy health officer of the Port of New York. Dr. DeForest has recently returned from Libau, Russia, where he has been in the Public Health Service for the last five years.